Study on Estimating and Decreasing of Visual Stress Level Caused by the Use of Computers in the Economic Field

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Abstract *The intensive use of computers in office work and its associated stressors, generate mental and physical demands regarding personnel engaged in this activity. This paper aims to assess the most significant psycho-physiological effects induced in a computer company and to identify direct and indirect symptoms of visual stress, perceived by staff working in the video terminals. Also very important are the organizational measures for the diminishing of visual stress that must be implemented by the employers. Finally some simple methods are summarized to reduce visual stress to be reached by every employee.*

Key words:
Ergonomics, indicators of visual stress, ways to combat visual stress

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1. Introduction

Today information and communication technology is involved in all areas of human activity and in this general context, office work is no exception.

Miscellaneous equipment, more sophisticated and powerful as digital phones, faxes, printers, copiers and scanners, personal computers and computer networks, graphics stations, equipment for recording and retrieval of information and many others have completely changed the appearance of traditional offices.

Office work and specific stressors generate intense mental and physical effects and diseases caused by them affect the employees in this business.

Therefore call ergonomics is absolutely necessary in order to increase productivity, while reducing fatigue and stress, induced to the employees.

As the International Labour Organization states "Ergonomics is the application of biological & human sciences, in conjunction with technologies to reach a mutual accommodation between man and his work, results being measured in efficiency indices and well being of man." A first step in optimizing the relationship in human-machine-environment system is to identify and assess the employee requests generated by the equipment they operate during their current activity.

2. Some results on the assessment of physiological stresses arising from computer use

The experienced managers say that most management problems we face are related to personnel, many of which are determined by aspects of efficient operation in conjunction with providing appropriate working conditions.

As is revealed in the literature in the context of office work, misuse of computer generated risks to worker safety and health. To achieve an ergonomic study on the subject we consider as necessary the following steps:

- a set of indicators on psycho-physical effects induced by the use of computers;
- evaluation based on these indicators of effects perceived by the questioned staff;
- identify key indicators (those with considerable weight on questionnaire responses);
- critical analysis of psycho-physical effects and making recommendations to reduce them.

Using this methodology, such a study was realised on staff employed by an independent firm, specialised on consulting services and online communications strategy. The company's customers include organizations and corporations operating in Romania the market and external market.

The company operates in leased space, divided the large premises of "open space" for creative and production departments as well as separate offices for customer service departments and administrative personnel. Working hours are 8 h with a lunch break of one hour for administrative, while for production staff the program is flexible.

The set of indicators on psycho-physical stresses induced by computer use, grouped according to physiological criteria is as follows:
- eye strain and other eye diseases;
- dizziness, rapid breathing and skin irritation;
- nervous tension, anger, fatigue, depression and sleep disorders;
- headaches and also neck, arm, shoulder, stomach and chest pains.

An anonymous character questionnaire was handed to the administration and production staff of the company. Responses were quantified as a percentage, in relation to the total amount of respondents and represents stresses received by them due to computer use.

Table 1. Percentage values of indicators on stresses arising from computer use

No.	Indicators	Weekly time spent on computer		
		< 15 h	15-30 h	>30 h
1	Eye strain	27%	34%	58%
2	Headaches	18%	25%	42%
3	Dizziness	2%	7%	6%
4	Sleep disorders	11%	9%	9%
5	Back pains	22%	28%	42%
6	Neck pains	16%	22%	35%
7	Arm pains	12%	21%	32%
8	Shoulder pains	21%	19%	34%
9	Fatigue	26%	29%	52%
10	Stomach pains	10%	13%	15%
11	Skin irritation	1%	2%	1%

No.	Indicators	Weekly time spent on computer		
		< 15 h	15-30 h	>30 h
12	Rapid breathing	6%	4%	2%
13	Chest pains	10%	9%	9%
14	Nervous tension	22%	18%	12%
15	Anger	1%	2%	4%
16	Depression	4%	3%	2%
17	Eye diseases	2%	4%	6%

The above data reveal the following:
- the whole extent of perceived personnel stresses increases with the number of hours spent at the computer;
- increased frequency indicators are: eye strain, headaches, back pain, neck pain, arm pain, shoulder pain, fatigue, stomach pain.

The computer induced stress indicators, from filled in questioners, having the percentage of at least 10% and for what the percentage value increases with increasing exposure time are presented in the following histogram.

Questionnaire responses highlight that eyestrain registers the highest percentage (27%, 34% and 58% for the three intervals of exposure) between main stress indicators and therefore has the greatest influence on labor productivity. This is the reason further analysis will be dedicated to the manifestations of visual stress along with some measures to reduce it.
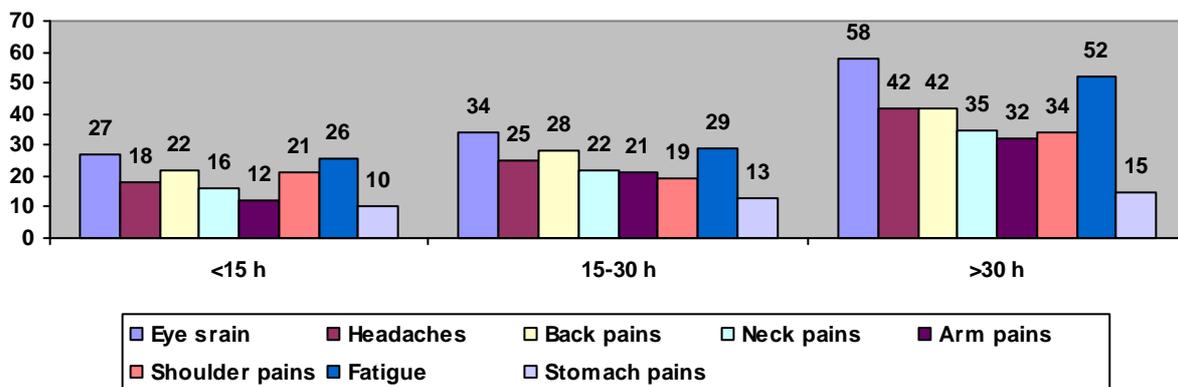

Figure 1 Evolution of main indicators of psycho-physical effects, depending of exposure time on the computer

3. Visual stress induced by computer use

As can be seen from the data above, intensive use of computer during working hours induces a series of employee health risks. A first observation is that when the time spent watching video terminal exceed 30 hours/week, over 50% of users complain eye disorders. The most common symptoms of direct visual stress observed in some studies, are:
- ocular pressure;
- look focusing difficulties;
- double image;
- changes in color perception;
- myopia.

Beyond these direct influences on vision system, scientists have identified some symptoms can include indirect effects such as: fatigue and nervous irritability, low visual efficiency activity, tension and pain in the neck, shoulders and arms, back pains.

All this contributes to the registration of common errors and a low speed range and ultimately lower overall productivity in office work.

Returning to the question of the impact of computer use on vision must be stressed that the human visual apparatus is adapted especially for distance vision.

Over a hundred thousand years, when they were exclusively hunters and gatherers, but over about ten thousand years, the main occupation was agriculture and livestock, people used mainly vision for the remote range. Only two centuries ago, when industrial workers are becoming the majority in the active population, human activity became involved in the variable range vision (distant-close-up plan). In the second half of past century with the increase of employees in office work, including those working in or adjacent to highly dynamic field of computer science, has become a necessity to accommodate vision to the foreground.

As a result, computer-generated visual stress in office work is an acute physiological imbalance, which the body is trying to mitigate in a specific way.

For many whom use the computer for a long time (more than 4 hours per day) the most frequent problem is eyestrain. The latter leads to lower labor productivity and also impair the ability to focus on and to well understand their duties.

Focus vision difficulties are a consequence of inertia (backwardness) that the human visual device displays when we need to accommodate to near vision. The backwardness depends on the difference between the distance at which the object is viewed (computer screen) and natural focus distance of the viewer (which is appreciably higher). Ergonomic comparative research in visual stress that has been to measure the focal length of human vision using laser technology, revealed that the eyes when watching a video terminal, focusing accuracy is lower than if the focus is on a printed page.

On the wide side, another concept used in assessing visual stress is called "point of relaxation and accommodation", which is the point where a person's eyes focus when it lacks the visual field factor capable of giving focused attention. If video terminal is used longer without a break the focal point of the eye moves beyond the display and approaching the point of relaxation, found in distant plan, which degrades perceived image on the computer screen.

Double image is due to a decrease in the ability to coordinate eyes, with direct effect on binocular vision. It is a temporary effect but it is useful to consult an ophthalmologist, to eliminate the possibility of other serious neurological dysfunction.

Changes in color perception are determined by constantly monitoring the screen for long periods, followed by switching the vision on background. The viewer can perceive the opposite or complementary colors that make up the background image on the screen. Although this may be alarming, it is not dangerous and disappears after a short time.

Finally, myopia may be caused by improper visual conditions (low light, the wrong position, permanent visual stress), or a genetic inheritance. When it is not genetic, myopia may be a poor way to adapt the visual device to close plan vision. Studies have revealed that myopia increases during periods of intense intellectual activity and decreases during the rest of visual system.

4. Some measures for the decrease of visual stress level and effects

So we can see the intensive computer use along the work program generate risks for the health of employers. These impose the commercial firms to follow first the endowments of compartments which administrate large volumes of dates and information, with modern equipments, designed and achieved according to the ergonomic principles.

Secondly, the executive firm leaders must introduce some organizational measures for the decrease of employer visual stress, such as ergonomic design of work place, suitable furniture or the assurance of the best office microclimate.

The work places chromatic ambiance and especially the reflection level for the decorative colors are the factors that influence the work productivity and have an important contribution to the visual stress decrease.

For this point of view it is recommended:

- the choice of a light color, with a reflection coefficient greater than 60%, for the ceiling in order to increase the light in the room, and at the same time to prevent the brilliance;
- the choice of a darker color for the floor, with a reflection coefficient about 15-30%;
- the choice of a lighter color for the furniture, with a reflection coefficient between 30% and 50%;
- the choice of neutral colors for computer equipments (gray or beige).

The office furniture for computer operators place must achieve a balanced report between comfort and functionality, and for that it is necessarily:

- adjustable chairs in height with adjustable chair back;
- supports for legs;
- supports for computer screens with adjustable arms in order to establish the position of screen center under the eyes level and to eliminate parasite reflections;
- supports for documents with adjustable arms;
- mobile supports for keyboards.

The physical ambiance of the work place includes factors such light, temperature, humidity and noise levels that must respond to specific office equipment solicitations, as bellow:

- a light level for the computer operator offices about 400-500 lx (for general purpose offices the recommended value is about 800-1000 lx);
- a temperature of 21-23 Celsius degrees, recommended for intellectual work in a seating position;
- a difference between outside and inside temperatures in the warm season not greater than 4 Celsius degrees;
- a relative air humidity level of 70% at a temperature of 22 Celsius degrees;
- a maximum noise level of 70 db (the phone ring sound intensity is 75 db).

In addition with the ergonomic computer design and implementing organizational protection measures there are others simple ways to reduce visual stress to reach by every employee, practicing in front of a video terminal.

Blinking is a reflex act of vision device that allows the eye to rest for a few fractions of seconds and helps clean and moisten the eye surface. Normally, a person blinks about 15 times per minute. Blinking rate is reduced when effort is strong and lasting through the eyes focus on details of the near plan vision. So after these times of maximum concentration is highly recommended voluntary blinking repeated until no sensation of eye irritation.

On the other hand, when we are extremely focused on work we tend to hold our breath, which causes involuntary contraction of muscle groups, including the composition of the visual apparatus. Maintaining a normal rate of respiration provides relaxation of these muscles, and helps reduce muscle tension even at eye level. In addition to reducing visual stress accumulated by using the computer, the human body needs breaks to relax eyes. For example, from 10 to 10 minutes during 10 seconds is recommended to focus the vision on a point in the background, blinking and breathing normally.

5. Final remarks

Ergonomic study conducted in a computer service organization has allowed detection of the most significant physiological effects, based on an extensive list of indicators of psycho-physical effects caused by computer use.

On this basis, were identified a series of direct and indirect symptoms of visual stress, perceived by staff working in the video terminals.

A computer's operating business with over 30 hours/week, for which humans are not biologically adapted, is able to determine a range of visual problems.

However, the importance of computer use in economic activities is undeniable. So, the technical and organizational measures to reduce the visual stress levels, which must be implemented by the employers, are of great importance.

Finally were summarized also some simple methods to reduce visual stress, available to every employee.

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